REMARKS

Claims 1-4 are pending.

Claims 5-20 have been cancelled without prejudice.

Claims 1-4 have been rejected.

New Claims 21-36 have been added.

No claims have been allowed.

Reconsideration of Claims 1-4 and Claims 21-36 is respectfully requested.

Amendment to the Specification

Paragraph [0030] on Page 9 of the Specification has been amended to correct typographical errors. The letters "ART" have been corrected to read "ARC". The letters "Tin" have been corrected to read "TiN". No new matter has been added by this amendment.

35 U.S.C. § 102(b) Anticipation

On Pages 2-3 of the June 29, 2005 Office Action, the Examiner rejected Claim 1 under 35 U.S.C. § 102(b) as being anticipated by United States Patent No. 5,427,666 to Mueller et al. (hereafter "*Mueller*"). The Applicants respectfully traverse the Examiner's position that the Applicants' invention is anticipated by the *Mueller* reference. The Applicants respectfully request the Examiner to withdraw the rejection of Claim 1 in view of the Applicants' arguments.

It is axiomatic that a prior art reference anticipates the claimed invention under 35 U.S.C. § 102 only if every element of a claimed invention is identically shown in that single reference, arranged as they are in the claims. MPEP § 2131; *See, In re King*, 231 USPQ 136, 138 (Fed. Cir. 1986) (citing with approval, *Lindemann Maschinenfabrik v. American Hoist and Derrick*, 221 USPQ 481, 485 (Fed. Cir. 1984)); *In re Bond*, 910 F.2d 831, 832, 15 USPQ2d 1566, 1567 (Fed. Cir. 1990). Anticipation is only shown where each and every limitation of the claimed invention is found in a single prior art reference. MPEP § 2131; *In re Donohue*, 766 F.2d 531, 534, 226 USPQ 619, 621 (Fed. Cir. 1985).

With respect to Claim 1, a determination of anticipation in accordance with Section 102 requires that each feature claimed therein be described in sufficient detail in *Mueller* to enable one of ordinary skill in the art to make and practice the claimed invention.

The Applicants respectfully disagree with the Examiner's assertions regarding the subject matter disclosed in the *Mueller* reference. The Applicants respectfully submit that the *Mueller*

reference does not show each and every limitation of the Applicants' invention. The Applicants direct the Examiner's attention to Claim 1, which contains unique and novel limitations:

> 1. (Original) In a semiconductor device of the type comprising a via wherein said via comprises a layer of titanium placed over a layer of anti-reflective coating (ARC) titanium nitride, a method for preventing a contaminant within said layer of anti-reflective coating (ARC) titanium nitride from combining with portions of said layer of titanium, said method comprising the steps of:
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> applying a nitrogen plasma to said layer of titanium; and
>
> converting said layer of titanium to a first layer of titanium nitride;
>
> wherein said contaminant does not chemically react with said first layer of titanium nitride. (Emphasis added).

The Examiner stated that "Mueller shows the method as claimed in figure 3B and corresponding text, with TiN (ARC) 58 and Ti layer 60, which protects the layer 58 from contaminants. Nitrogen plasma is used to form the TiN." (June 29, 2005 Office Action, Page 3, Lines 1-3). The Applicants respectfully traverse these conclusions of the Examiner for the following reasons.

The *Mueller* reference identifies an unwanted contaminant layer 50 of titanium nitride (TiN) in the prior art structure shown in FIGURE 3A. The *Mueller* reference provides a method for solving the prior art TiN contamination problem. "The present invention [Mueller] solves the TiN contamination problem by utilizing a unique and novel processing step." (*Mueller*, Column 4, Lines 63-64).

The *Mueller* reference describes a method for applying a titanium layer 60 to a layer of TiN anti-reflective coating 58. Mueller states "As shown in FIG. 3B, after a layer of TiN anti-

reflective coating 58 is deposited on the silicon wafer, an additional thin Ti layer 60 is deposited on top of the anti-reflective coating layer 58. This cleaning step for the Ti target is necessary only when Ti and TiN are deposited on the surface of a silicon wafer in the same process chamber. . . . [A]fter the anti-reflective coating of TiN [TiN layer 58] is deposited, a thin layer of Ti [Ti layer 60] is deposited on top of the TiN layer [TiN layer 58]. This additional Ti deposition [Ti layer 60] constitutes the final step for the TiN ARC deposition process. It removes the contaminant TiN layer on the target surface and presents a clean target ready to be used in processing the next wafer." (*Mueller*, Column 4, Line 65 to Column 5, Line 12) (Emphasis added).

A careful reading of the *Mueller* reference shows that, unlike the Applicants' method as claimed in Claim 1, the *Mueller* method does not apply a nitrogen plasma to Ti layer 60. *Mueller* states that the deposition of the Ti layer 60 is the final *step* in the *Mueller* method. No further processing takes place. Furthermore, unlike the Applicants' method as claimed in Claim 1, the *Mueller* method does not convert the Ti layer 60 to titanium nitride (TiN).

In the *Mueller* method the contaminant is titanium nitride (TiN). The *Mueller* reference states "The Ti layer 60 deposited on the silicon wafer over the TiN [TiN layer 58] contains a small amount of impurity of TiN which is removed from the target surface." (*Mueller*, Column 5, Lines 15-17). The TiN on the target surface is also referred to as a "contaminant TiN layer." (*Mueller*, Column 5, Lines 10-12).

Claim 1 is directed to a method for preventing a contaminant within a layer of anti-reflective coating (ARC) titanium nitride (analogous to ARC TiN layer 58) from combining with portions of a titanium layer (analogous to titanium layer 60) placed over the anti-reflective coating (ARC) titanium nitride. There is no "contaminant" in the ARC TiN layer 58 of *Mueller* because the entire layer 58 is made of titanium nitride.

The Examiner also stated that the titanium layer 60 of *Mueller* protects the ARC TiN layer 58 from contaminants. Even if this were so, it is clear that the contaminants would be external to the titanium layer 60. The protection, if any, provided by titanium layer 60 to the ARC TiN layer 58 is not relevant to a method that prevents a contaminant within an ARC TiN layer from combining with portions of a titanium layer placed over the ARC TiN layer.

The *Mueller* method does not anticipate the Applicants' method because (1) *Mueller* does not describe any contaminant within the ARC TiN layer 58, and (2) *Mueller* only describes a titanium nitride (TiN) contaminant within the titanium layer 60, and (3) *Mueller* does not apply a nitrogen plasma to titanium (Ti) layer 60, and (4) *Mueller* does not convert the titanium (Ti) layer 60 to titanium nitride (TiN).

For the reasons set forth above, the Applicants respectfully submit that Claim 1 is in condition for allowance. Allowance of Claim 1 is respectfully requested.

35 U.S.C. § 103(a) Obviousness

On Pages 3-4 of the June 29, 2005 Office Action, the Examiner rejected Claims 2-4 under 35 U.S.C. § 103(a) as being unpatentable over United States Patent No. 5,427,666 to *Mueller* in view of United States Patent No. 6,399,508 to Ting et al. (hereafter, "*Ting*"). The Applicants respectfully traverse the Examiner's position that the Applicants' invention is obvious in view of the *Mueller* reference and the *Ting* reference. The Applicants respectfully request the Examiner to withdraw the rejection of Claims 2-4 in view of the Applicants' arguments.

During *ex parte* examinations of patent applications, the Patent Office bears the burden of establishing a *prima facie* case of obviousness. MPEP § 2142; *In re Fritch*, 972 F.2d 1260, 1262, 23 USPQ2d 1780, 1783 (Fed. Cir. 1992). The initial burden of establishing a *prima facie* basis to deny patentability to a claimed invention is always upon the Patent Office. MPEP § 2142; *In re Attacker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); *In re Passaic*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). Only when a *prima facie* case of obviousness is established does the burden shift to the applicant to produce evidence of non-obviousness. MPEP § 2142; *In re Attacker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); *In re Rijckaert*, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993). If the Patent Office does not produce a *prima facie* case of unpatentability, then without more the applicant is entitled to grant of a patent. *In re Attacker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); *In re Grabiak*, 769 F.2d 729, 733, 226 USPQ 870, 873 (Fed. Cir. 1985).

A *prima facie* case of obviousness is established when the teachings of the prior art itself suggest the claimed subject matter to a person of ordinary skill in the art. *In re Bell*, 991 F.2d 781, 783, 26 USPQ2d 1529, 1531 (Fed. Cir. 1993). To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed invention and the reasonable expectation of success must both be found in the prior art, and not be based on an applicant's disclosure. MPEP § 2142.

For the reasons set forth below the Applicants respectfully submit that the Patent Office has not established a *prima facie* case of obviousness with respect to Claims 2-4 of the Applicants' invention. In rejecting Claims 2-4 the Examiner stated:

> Mueller shows the method substantially as claimed and as described in the previous paragraphs.
>
> Mueller lacks anticipation only in not teaching that the contaminant may be fluorine and that the application of the nitrogen plasma increases a temperature of the semiconductor device to approx. 400 degrees C.
>
> Ting teaches etching of TiN and TiN in a fluorine atmosphere to pattern the layers.
>
> It would have been obvious to one of ordinary skill in the art that the Ti layer over the TiN ARC, as taught, by Mueller, would protect the TiN layer from the damage caused by subsequent patterning using fluorine, with the motivation that the Ti layer would act as a barrier to the fluorine atoms.
>
> It would have been obvious to one of ordinary skill in the art to have increased a temperature of a semiconductor device to approx. 400 degrees C by the

> application of the nitrogen plasma, in the method of Mueller, with the motivation that the plasma nitridation process may be performed conventionally while heating the substrate to such a temperature. (June 29, 2005 Office Action, Page 4).

The Applicants respectfully traverse these conclusions of the Examiner. The Applicants hereby reiterate and incorporate by reference all of the reasons and arguments previously set forth with respect to the *Mueller* reference in connection with the rejection of Claim 1 above. For the reasons and arguments previously set forth, the Applicants respectfully traverse the assertion of the Examiner that "Mueller shows the method substantially as claimed and as described in the previous paragraphs." (June 29, 2005 Office Action, Page 4, Lines 3-4).

The Applicants agree that the *Mueller* reference does not disclose any teaching that the contaminant is fluorine or any teaching concerning the application of a nitrogen plasma to increase the temperature of the semiconductor device to approximately 400 degrees Celsius.

The Applicants respectfully submit that the *Ting* reference does not and can not supply the deficiencies of the *Mueller* reference. *Ting* teaches the use of a plasma generated from a source gas comprising Cl_2, BCl_3, and CHF_3 to etch an anti-reflective coating layer. (*Ting*, Column 6, Pages 19-20). There is no mention in *Ting* of fluorine being a contaminant in an anti-reflective coating (ARC) titanium nitride (TiN) layer.

The Applicants respectfully traverse the Examiner's assertion that it would have been obvious to one having ordinary skill in the art "that the Ti layer over the TiN ARC, as taught in Mueller, would protect the TiN layer from the damage caused by subsequent patterning using

fluorine, with the motivation that the Ti layer would act as a barrier to the fluorine atoms." (June 29, 2005 Office Action, Page 4, Lines 9-12).

First, the supposed motivation "that the Ti layer would act as a barrier to the fluorine atoms" is very general and does not specifically suggest combining the teachings of the *Mueller* reference with the teachings of the *Ting* reference. There must be some suggestion or motivation, either in the references themselves, or in the knowledge generally available to one of ordinary skill in the art, to modify a reference or to combine reference teachings. The desire to have "a titanium (Ti) layer that would act as a barrier to fluorine atoms" is too general and vague to provide the requisite motivation to modify a reference or to combine reference teachings.

Second, the supposed motivation "that the Ti layer would act as a barrier to the fluorine atoms" has nothing to do with the Applicants' invention. In the Applicants' method a titanium layer 310 that is located over an ARC TiN layer 130 is converted into a titanium nitride layer 810 by the application of a nitrogen plasma. The fluorine contaminant in the Applicants' method is located in the underlying ARC TiN layer 130. There is no fluorine contaminant from an "etching" process conducted in a "fluorine atmosphere" as described by *Ting*. There is no "subsequent patterning using fluorine" in the Applicants' method.

The Applicants respectfully submit that one skilled in the art would not attempt to combine the teachings of the *Mueller* reference with the teaching of the *Ting* reference. The Applicants also respectfully submit that a combination of the *Mueller* method and the *Ting* method would be unworkable. The *Ting* method is not compatible with the *Mueller* method.

For this reason there would be no suggestion or motivation to combine the teachings of the *Ting* reference with the teachings of the *Mueller* reference.

In order to establish obviousness by combining references there must be some teaching or suggestion in the prior art to combine the references. *Arkie Lures, Inc. v. Gene Larew Tackle, Inc.*, 119 F.3d 953, 957, 43 USPQ2d 1294, 1297 (Fed.Cir. 1997) ("It is insufficient to establish obviousness that the separate elements of an invention existed in the prior art, absent some teaching or suggestion, in the prior art, to combine the references."); *In re Rouffet*, 149 F.3d 1350, 1355-56, 47 USPQ2d 1453, 1456 (Fed.Cir. 1998) ("When a rejection depends on a combination of prior art references, there must be some teaching, or motivation to combine the references.")

Evidence of a motivation to combine prior art references must be clear and particular if the trap of "hindsight" is to be avoided. *In re Dembiczak*, 175 F.3d 994, 50 USPQ2d 1614 (Fed.Cir. 1999) (Evidence of a suggestion, teaching or motivation to combine prior art references must be "clear and particular." "Broad conclusory statements regarding the teaching of multiple references, standing alone, are not 'evidence.'"). *In re Roufett*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457 (Fed.Cir. 1998) ("[R]ejecting patents solely by finding prior art corollaries for the claimed elements would permit an examiner to use the claimed invention itself as a blueprint for piecing together elements in the prior art to defeat the patentability of the claimed invention. Such an approach would be 'an illogical and inappropriate process by which to determine patentability.'")

The Applicants respectfully submit that the alleged motivation to combine references presented by the Examiner does not meet the legal requirement to establish a finding of *prima facie*

obviousness. The Applicant respectfully submits that the alleged motivation to combine references is not clear and particular. The fact that two references are concerned with the same general technical area does not without more provide a "clear and particular" motivation to combine the references. The Applicant respectfully submits that the alleged motivation to combine references has been assumed by "hindsight" in light of the existence of the Applicant's invention.

Even if the *Mueller* reference could somehow be combined with the *Ting* reference, the combination would not teach, suggest, or even hint at the Applicant's invention as set forth in Claims 2-4. MPEP § 2142 indicates that a prior art reference (or references when two or more references are combined) must teach or suggest all the claim limitations of the invention. The teaching or suggestion to make the claimed invention and the reasonable expectation of success must both be found in the prior art, and not be based on an applicant's disclosure. In the present case, the *Mueller* reference and the *Ting* reference in combination would not teach or suggest all the claim limitations of the Applicant's invention.

Lastly, the Applicants respectfully traverse the Examiner's assertion that it would have been obvious to one having ordinary skill in the art "to have increased a temperature of the semiconductor device to approx. 400 degrees C by the application of the nitrogen plasma, in the method of Mueller, with the motivation that the plasma nitridation process may be performed conventionally while heating the substrate to such a temperature." (June 29, 2005 Office Action, Page 4, Lines 13-16). First, the supposed motivation "that the plasma nitridation process may be performed conventionally" is very general and does not specifically suggest modifying the teachings of the

Mueller reference. There must be some suggestion or motivation, either in the references themselves, or in the knowledge generally available to one of ordinary skill in the art, to modify a reference or to combine reference teachings. The desire to perform a "conventional plasma nitridation" is too general and vague to provide the requisite motivation to modify a reference or to combine reference teachings.

Second, combining a plasma nitridation process with the *Mueller* method does not overcome or supply the deficiencies of the *Mueller* method that have been previously described.

The Applicants note that Claims 2-4 depend directly or indirectly from Claim 1. As previously described, Claim 1 contains unique and novel claim limitations of the Applicants' invention. Therefore, Claims 2-4 also contain the same unique and novel claim limitations of Claim 1 and are therefore patentable over the *Mueller* reference and the *Ting* reference, either separately or in combination.

The Applicants respectfully submit that Claims 1-4 are in condition for allowance. Allowance of Claims 1-4 is respectfully requested.

The Applicants have submitted new Claims 21-36 to further claim the unique and novel features of the Applicants' invention. For the reasons set forth above, the Applicants respectfully submit that the new Claims 21-36 are also in condition for allowance. Allowance of Claims 21-36 is also respectfully requested.

The Applicants' attorney has made the amendments and arguments set forth above in order to place this Application in condition for allowance. In the alternative, the Applicants' attorney has made the amendments and arguments to properly frame the issues for appeal. In this Amendment, the Applicants make no admission concerning any now moot rejection or objection, and affirmatively deny any position, statement or averment of the Examiner that was not specifically addressed herein.

SUMMARY

Entry of this amendment is respectfully requested. If any outstanding issues remain, or if the Examiner has any further suggestions for expediting prosecution of this Application, the Applicants respectfully invite the Examiner to contact the undersigned at the telephone number indicated below or at *dvenglarik@davismunck.com.*

Respectfully submitted,

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